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AUTHOR Parker, Dawn
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ABSTRACT

This study describes the existing "state of the state" with regard to preservice elementary science preparation at colleges and universities in Texas. Data consisted of responses from 61 educational institutions involved in elementary teacher preparation on a 50-item survey mailed to 98 institutions in Texas. Data analysis focused on categories that represented the ways in which programs teach science and science pedagogy, collaborate among faculties of science and faculties of education, provide essential field experiences, and prepare for professional growth and development. Texas elementary preparation programs were generally traditional in delivery of science content and pedagogical practice, and collaborative partnerships at educational institutions throughout the state were limited. Most institutions designed and implemented programs within departments--communicating and cooperating with other departments or school districts only when necessary to handle state guidelines and requirements. Opportunities for early field-based experiences were limited; however, institutions from across the state recognized the importance of early field work and indicated a need for more information on how to implement this component into certification or preparation programs. Other institutions indicated professional development opportunities which generally included workshops, seminars, and mentor programs. Appendices contain the survey and a list of the institutions surveyed. Contains 11 references. (Author/PVD)

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PRESERVICE ELEMENTARY SCIENCE PROJECT

Preservice Elementary Science Preparation:

A Description of Programs at Colleges and Universtities in Texas

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Texas SSI Action Team for the Preparation of Prospective Elementary Teachers in Science

Texas Statewide Systemic Initiative

September 1996

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Working Draft

Texas SSI Action Team for the Preparation
of Prospective Elementary Teachers in Science

Texas Statewide Systemic Initiative

September 1996

ACTION TEAM FOR THE PRESERVICE ELEMENTARY SCIENCE PROJECT

Mary Jane Schott, Science Specialist
Texas Statewide Systemic Initiative

Carol L. Stuessy, Action Team Chair
Texas A&M University

Dawn Parker, Graduate Assistant
Texas A&M University

Andrea Foster, Graduate Assistant
Texas A&M University

Treasure Brasher
West Texas A&M University

Fred Fifer
University of Texas at Dallas

Janett Frentress
Ector County Independent School District

Cecilia Gonzales
San Antonio College

Margaret Hammer
Aldine Independent School District

Julia Jackson
Education Service Center, Region 2

Shirley Key
University of Houston-Downtown

Elva Laurel
University of Texas at Brownsville

Jim McNamara
Texas A&M University

Sherri Nichols
University of Texas at Austin

Michelle Reynolds
Huntsville Christian Academy

Richard Romero
El Paso Independent School District

Sharon Sledge
San Jacinto College

Julie Thomas
Texas Tech University

Vanessa Westbrook
Texas Statewide Systemic Initiative

Ellen White-Volk
Jefferson Methodist Learning Center

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This document was prepared by Dawn Parker, Graduate Assistant, Texas A&M University. For information, contact (409) 845-8005.

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[1]Raw survey data is available upon request.

Abstract

The intent of this study was to describe the existing *state of the state* with regard to preservice elementary science preparation at colleges and universities in Texas. Data consisted of responses from 61 Texas educational institutions involved in elementary teacher preparation on a 50 item survey mailed out to 98 institutions in the state of Texas. Data analysis focused on categories that represented the various ways in which programs teach science and science pedagogy, collaborate among faculties of science and faculties of education, provide essential field experiences, and prepare for professional growth and development. Content analysis of survey responses showed that Texas elementary preparation programs were generally traditional in delivery of science content and pedagogical practice and that collaborative partnerships at educational institutions throughout the state were limited. Most institutions designed and implemented programs within departments--only communicating and cooperating with other departments or school districts when necessary to handle state guidelines and requirements. Opportunities for early field-based experiences were also limited. However, there were institutions across the state that recognized the importance of early field work and indicated a need for more information on how to implement this component into certification programs or preparation programs. In addition, there were institutions that indicated professional development opportunities which generally included workshops, seminars, and mentor programs.

Introduction

The undergraduate education of those who intend to teach science is a critical element in achieving levels of science literacy. Those teaching science pass their understanding of the nature of science to the students they teach. In the last decade, several significant steps have been taken at the national, state, and local levels to strengthen and improve science education. The impetus to formulate national goals has accelerated national initiatives to improve elementary science education. These initiatives have included projects funded by the National Science Foundation; other projects national in scope, such as AAAS's Project 2061 and NSTA's Scope, Sequence, and Coordination; and statewide systemic initiatives (Raizen & Michelsohn, 1994). These initiatives have recognized the importance of effective teacher preparation and have been catalysts in reform efforts to better prepare future teachers of science.

Many teacher preparation programs lack focus and vision. Autonomy is limited because of state mandates for certification that are based on course requirements rather than on program outcomes (Goodlad, 1990). In the traditional elementary education program, prospective teachers fulfill a series of general education requirements, usually followed by a number of professional education courses that can be taken in any order. The education courses in the teacher education programs consist of methods courses and other courses in such areas as educational psychology. The science courses required of the elementary education major usually employ didactic, lecture-based approaches that convey information from the "expert to the novice." Following these courses, education majors typically engage in a semester's worth of "student teaching" during which they assume increasing responsibilities in the classroom (Michelsohn & Hawkins, 1994). Many courses offered in teacher education programs do not relate science content to pedagogy, nor do they provide substantial opportunities to experience the teaching of science in authentic classroom settings. Few connections are made between the theory

studied in university-based course work and the classroom-based experiences in elementary grades that make up the student teaching experience (Raizen & Michelsohn, 1994).

The traditional view of teacher preparation programs does not match suggested reform efforts that realize the important role of the teachers in the process. The greater the involvement of the teachers, the greater the probability of sustaining systemic improvements. Educational reform is a shared responsibility. Collaborative partnerships among the educational and the scientific communities, preservice teachers, and experienced teachers are essential and beneficial to the development of future teachers of science (AAAS, 1990). Collaborative partnerships are vehicles for professional development and continual growth, as well as a means to strengthen the science courses offered at the undergraduate level (Raizen & Michelsohn, 1994). Prospective elementary teachers need both breadth and depth to their understanding of science. Therefore, it is important for colleges and universities to reshape their elementary teacher preparation programs to provide opportunities for preservice teachers to gain an understanding of science and science teaching (AAAS, 1990). The learning of essential science content through methods of inquiry provides preservice teachers with opportunities to actively investigate and reflect on scientific phenomena (NRC, 1996).

To aid in the restructuring of teacher preparation programs in Texas, national and state initiatives are supporting reform efforts. The Texas Statewide Systemic Initiative, supported by funds from the National Science Foundation and the Charles A. Dana Center for Mathematics and Science Education, began a major statewide project to strengthen the science preparation of prospective elementary teachers in the summer of 1995. A major project goal is to help universities and colleges develop and improve undergraduate science courses for preservice teachers, with a vision of elementary teachers who continue to grow in their abilities to integrate content knowledge and pedagogical skills in teaching science that is relevant to the lives of developing children.

To assist in reaching this project goal, an action team has been formed consisting of individuals representing institutions most responsible for preparing elementary teachers (i.e., two- and four-year university and college faculty, public school curriculum specialists, educational service center specialists, and master teachers). The activities of the action team focus on establishing priorities at the state level for undergraduate teacher preparation, and at the institutional level for developing model courses that would strengthen the science preparation of prospective elementary teachers. In order to establish these state priorities and develop model courses to strengthen elementary teacher preparation, it is important to understand how educational institutions in Texas currently prepare prospective elementary teachers in science. Therefore, it is the intent of this paper to describe the existing *state of the state* with regard to preservice elementary science preparation, as well as to determine common characteristics and concerns among educational institutions in Texas.

Methodology

Instrument Design

The Preservice Elementary Science Survey was a 50 question, multiple format survey (see Appendix B for complete survey) designed to describe preservice elementary science certification and/or preparation programs in Texas. Survey questions were designed to address how educational institutions were meeting the needs of prospective elementary teachers, including the content and structure of science courses and experiences for their preparation, induction, and continued growth as teachers of science. Therefore, survey questions concerning the institution's teacher certification program, the science preparation of preservice elementary teachers, and the content and teaching of science courses at the institution were included. Respondents were asked to reflect on their individual practices and on the practices of their institution.

Procedure

Contact letters soliciting names of faculty at educational institutions in Texas were sent to 130 colleges and universities across the state during the summer of 1995--one communication was sent in July, a second in August. One hundred sixty individuals within the science and education departments at 98 educational institutions expressed an interest in fulfilling the role of educational institution contact for the preservice elementary science project. The Preservice Elementary Science Survey was sent to the 98 participating institutions to gather descriptive data related to preservice elementary science preparation.

Survey responses were coded and content analysis was used in order to describe preservice elementary science programs in Texas. Common characteristics and concerns were also identified among educational institutions.

Respondents

The preservice elementary science survey was sent to 160 individuals representing the science and education departments at 98 colleges and universities in Texas. One hundred individuals responded to the survey. These individuals represented 61 educational institutions dispersed across Texas. These institutions were demographically representative of colleges and universities in Texas. Institutions were organized into four categories based on the existence of elementary certification programs and/or preparation programs at the institution. These categories included public institutions with certification programs, private institutions with certification programs, institutions with preparation programs only, and institutions having no elementary certification or preparation program but indicating an interest in strengthening science education (Figure 1).

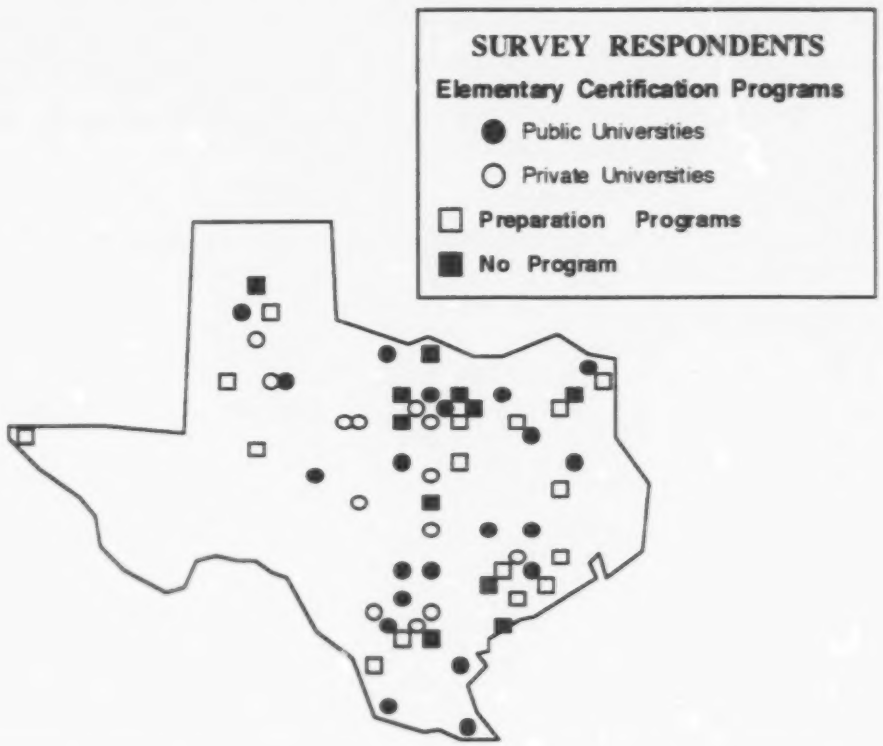

Figure 1.
Demographic representation of responding colleges and universities (n = 61)

Table one represents the breakdown of the institutions by category that were contacted and that particapated in the Preservice Elementary Science Survey. Table two represents the numbers of science and education department respondents in each of the four categories.

Table 1.
Preservice Elementary Science Survey: Institution Response Patterns

Type of Institution	Number of Institutions Contacted	Number of Institutions Responding
Public Institutions with Certification Programs	33	21
Private Institutions with Certification Programs	19	13
Institutions with Preparation Programs	16	16
No Elementary Education Program	11	11
Institutions Not Classified	19	0
Totals	98	61

Table 2.
Preservice Elementary Science Survey: Individual Response Patterns

Type of Institution	Respondents Science Departments	Respondents Education Departments	Respondent Totals
Public Institutions with Certification Programs	21	17	38
Private Institutions with Certification Programs	4	16	20
Institutions with Preparation Programs	25	3	28
No Elementary Education Program	13	1	14
Totals	63	37	100

Analysis of Survey Responses

Other studies of preservice teacher preparation programs have examined the requirements, structure, and philosophy of various programs (Mechling, Stedman, and Donnelan, 1982; Penick, 1987). However, the results of this study primarily focused on course content and program goals rather than structural features such as the number of required hours for program certification. Data analysis focused on categories which represented the various ways in which programs teach science and science pedagogy, collaborate among faculties of science and faculties of education, provide essential field experiences, and prepare for professional growth and development. The overall program structure was considered when necessary to determine any innovations incorporated into elementary teacher preparation to reach or strengthen program goals (Michelsohn and Hawkins, 1994).

Results

Category 1: Teaching of Science and Science Pedagogy

Teaching Style

Survey Question: What is your predominant teaching style?

Content analysis of the responses on this open-ended survey question concerning the predominant teaching style of all survey respondents resulted in four categories: *lecture*, *inquiry*, *hands-on*, and *interactive*. Of the 77 respondents answering this question, 51% indicated lecture as their predominant teaching style, 17% preferred a hands-on approach, 14% employ an interactive approach using discussion and technology in their teaching, and 13% indicated a preference to inquiry-based teaching. The remaining 5% indicated they used whatever method was necessary to convey the material.

The following was a typical comment from respondents regarding the predominant teaching style of lecture. "I typically lecture, provide demonstrations and laboratory assignments." Respondents indicated a preference to a hands-on approach. The following was a typical comment for this category. "Hands-on activities using cooperative learning groups are typically used." Also, the following was a typical comment from respondents indicating the use of whatever method was necessary to convey the material. "To be a learning catalyst for the student by whatever approach is needed." A comparison of the responses from public and private institutions with certification programs, institutions with preparation programs, and institutions with no program revealed that the teaching style of lecture was consistently the highest.

Laboratory Experience

Survey Question: Are there science laboratory experiences provided for prospective elementary teachers at your institution?

Seventy-five percent of the institutions indicated that science laboratory experiences were provided for prospective elementary teachers, 12% said no science laboratory opportunities were offered, and five percent of the institutions were not sure as to the provision of science lab experiences for prospective elementary teachers. Eight percent of the educational institutions did not respond to this question (Figure 2).

Institutions having no elementary certification or preparation program had a high "no response" percentage. Respondents in this category indicated this question was not applicable for their institution. However, it should be realized that many prospective teachers take science courses at these institutions and later transfer credits to institutions providing elementary certification. Of those institutions with certification programs or preparation programs, over 80% of them indicated science laboratory experiences. Institutions providing science laboratory experiences were asked to describe these opportunities. These descriptions focused on four categories. Thirty-eight percent

discussed science courses with *traditional labs*, 29% indicated labs with *transferable content* for the classroom, and 13% focused on labs providing opportunities for *hands-on activities*. Twenty percent of the responses fell into the final category and dealt with *structural components*, such as length of time and number of required lab hours. The following was a typical comment from respondents regarding structural components for laboratory experiences. "All science courses have mandatory labs of 3-4 hours a week."

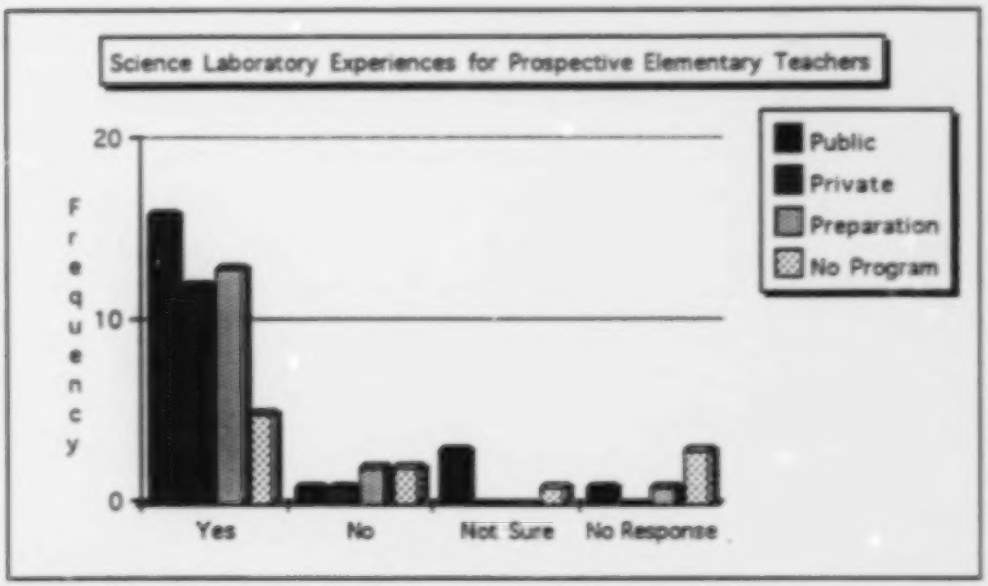

Figure 2. Frequency of Responses from Institutions (n=61)
Are science laboratory experiences provided for prospective elementary teachers at your institution?

Technology Use

Survey Question: Are various technologies (i.e., computers, multimedia, laboratory equipment) used in the science education courses at your institution?

Results indicated that 92% of the respondents use technology in the science course(s) at their institution, while five percent said they did not use various technologies in the science education courses offered at their institution. The remaining three percent did not respond to this question (Figure 3).

In all four institution categories, there was a high percentage of "yes" responses to the use of technology in science education or general science courses. However, content analysis of "yes" responses primarily indicated the use of technology for *instructional delivery* (i.e., lecture presentations, class demonstrations). Responses discussed the use of standard laboratory equipment and computers for *laboratory simulations*. The following was a typical comment from respondents regarding the use of various technologies in the science courses at their institution. "Multimedia is used in lectures and tutorials. Standard undergraduate laboratory equipment is used in biology, chemistry, and physics labs." Finally, there were a small number of responses that described the use of the *internet and E-mail* in the science course(s) offered at the institution. The following comments were representative of responses for this category. "We use the internet for a variety of science resources." "Students send assignments via E-mail."

Instructional Practice

Respondents were provided a list of items (see Figure 4) and were asked to reflect on each item in terms of their instructional practice. Response options included: (1) need more information; (2) aware of the general principles; (3) would like to try in my class; (4) have tried somewhat; and (5) have incorporated as part of my class. Results show the various instructional approaches occurring at educational institutions in Texas, with items in bold print indicating most frequent responses (Figure 4).

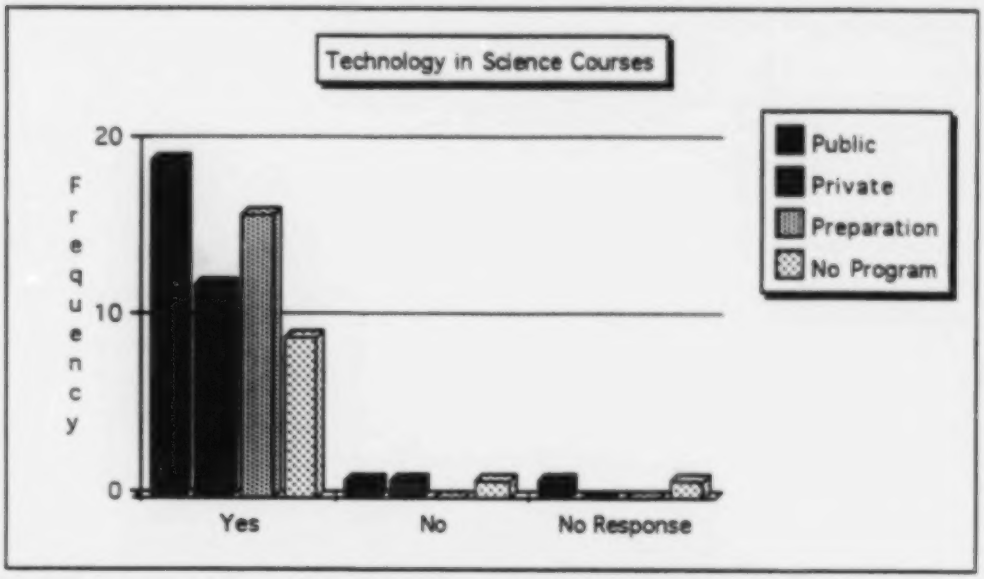

Figure 3. Frequency of Responses from Institutions (n=61)
Are various technologies (i.e., computers, multimedia, laboratory equipment) used in the science education or general sciences courses at your institution?

Noteworthy is the number of respondents who indicated a need for more information on alternative assessment. While there were no respondents from public institutions that indicated this need, there were nine respondents that indicated an awareness only of the general principles. Respondents of preparation program institutions also indicated a need for more information on field experiences in schools. Generally, individuals indicated team teaching had been tried or more information was needed in preparation program institutions while individuals of private and public institutions had tried somewhat or incorporated team teaching as part of their course(s). There was a difference between the overall item responses from individuals representing institutions with preparation programs and public and private institutions. For preparation programs, 39 of the respondents indicated a need for more information for a single item. Only one respondent indicated a need for more information for single items in the public institution category, and eight respondents needed more information for items provided in the private institution category.

Individuals from Public Institutions with Certification Programs: (n = 38)	Frequency of Response					
	1	2	3	4	5	No Response
Cooperative Learning	0	2	0	1	**26**	9
Alternative Assessment	0	9	1	3	**17**	8
Integration of Technology	0	2	2	**15**	11	8
Hands-on Labs	0	2	1	3	**24**	8
Field Experiences in Schools	1	3	5	2	**14**	13
Team Teaching	0	2	1	**12**	**12**	11
Real-world Applications	0	2	0	2	**25**	9
Open-ended Problem Solving	0	4	0	2	**21**	11

Individuals from Private Institutions with Certification Programs: (n = 20)	Frequency of Response					
	1	2	3	4	5	No Response
Cooperative Learning	1	3	1	0	**10**	5
Alternative Assessment	**4**	2	0	4	4	6
Integration of Technology	0	4	1	5	4	6
Hands-on Labs	0	1	1	0	**12**	7
Field Experiences in Schools	1	3	2	2	4	8
Team Teaching	1	3	1	**5**	**5**	**5**
Real-world Applications	1	1	1	3	**8**	6
Open-ended Problem Solving	0	3	1	3	**8**	5

Individuals from Institutions with Preparation Programs: (n = 28)	Frequency of Response					
	1	2	3	4	5	No Response
Cooperative Learning	6	3	1	4	**9**	5
Alternative Assessment	**11**	3	2	3	3	6
Integration of Technology	1	2	4	8	**10**	3
Hands-on Labs	2	0	1	2	**19**	4
Field Experiences in Schools	**10**	5	1	0	4	**8**
Team Teaching	5	**8**	1	5	4	5
Real-world Applications	2	1	3	7	**11**	4
Open-ended Problem Solving	2	4	3	5	**9**	5

Individuals from Institutions with No Program: (n = 14)	Frequency of Response					
	1	2	3	4	5	No Response
Cooperative Learning	1	1	0	**4**	**4**	**4**
Alternative Assessment	4	0	0	3	2	5
Integration of Technology	1	1	2	2	5	3
Hands-on Labs	0	0	0	0	**10**	4
Field Experiences in Schools	2	2	1	2	1	6
Team Teaching	0	3	2	2	0	7
Real-world Applications	1	1	0	2	5	5
Open-ended Problem Solving	0	1	1	3	3	6

Figure 4.
Results of respondents' instructional practices (n = 100) on a survey question in which the response scale was 1 = Need more information
2 = Aware of the general principles
3 = Would Like to try in my class
4 = Have tried somewhat
5 = Have incorporated as part of my class

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Category 2: Collaborative Program Design

Curriculum Development

Survey Question: How are curriculum guidelines for the science courses or course sequence established at your institution?

Respondents were asked to respond to a partially closed-ended survey question to specify how curriculum guidelines were determined for the science courses or course sequence at their institution. Forty percent of the respondents noted that course instructors were responsible for curricular decisions at their institution, 26% of the respondents said that curriculum guidelines were determined by the department at their institution, 23% indicated curriculum guidelines were set and well established at their institution, and three percent of the respondents were not sure as to how curriculum guidelines were determined at their institution. The remaining eight percent did not respond to this question.

Survey Question: Indicate the documents of which you are aware: (1) Benchmarks for Science Literacy (American Association for the Advancement of Science); (2) The National Science Education Standards (National Research Council); and (3) Texas Essential Elements of Instruction.

In terms of national and state documents, 72 of the 100 respondents indicated an awareness of Texas Essential Elements, 48 respondents indicated an awareness of the National Science Education Standards, and 42 respondents were aware of the Benchmarks for Science Literacy. There were also 22 individuals who chose not to respond to this question.

Communication Between Science and Education Departments

Survey Question: Is there communication between the science department and the education department at your institution?

Fifty-seven percent of the institutions responding indicated that there was a communication link between departments at their institution; 11% said there was no

communication between departments; and two percent were unsure of the communication between departments. There was a "no response" rate of 10% for this question. This question was not applicable to 20% of the institutions since these institutions did not have both a science and education department (Figure 5).

Results from preparation program institutions and no program institutions both yielded high percentages for the "no" and "no response" categories. On the other hand, public institutions and private institutions both indicated a high number of responses in the "yes" category. Those respondents indicating communication between departments at their institution were asked to describe this communication. Responses fell into three general categories: *committee meetings, advisory groups or councils* (36%); *"talking" or informal discussions* (36%); and *planning courses or determining curriculum* (28%). The following was a typical comment from respondents regarding communication practices between departments when designing courses. "Science methods curriculum is updated by instructors with input from science department faculty." Also, communication between departments occurred through informal discussions. The following is a typical comment. "We talk but there is no formal program to prepare elementary teachers to teach science." Other than the mention of periodic meetings, none of the responses indicated a sustaining communication between departments.

Collaboration with School Districts or Region Service Centers

Survey Question: Have school districts and/or region service centers provided input to you concerning what is important information to be taught in science courses for elementary teachers?

Fifty-seven percent of the respondents said that there was no input provided by school districts or region service centers at their institution while 27% of the respondents indicated that there was some type of input provided to their institution regarding science course content. Nine percent of the respondents were not sure of the input received from

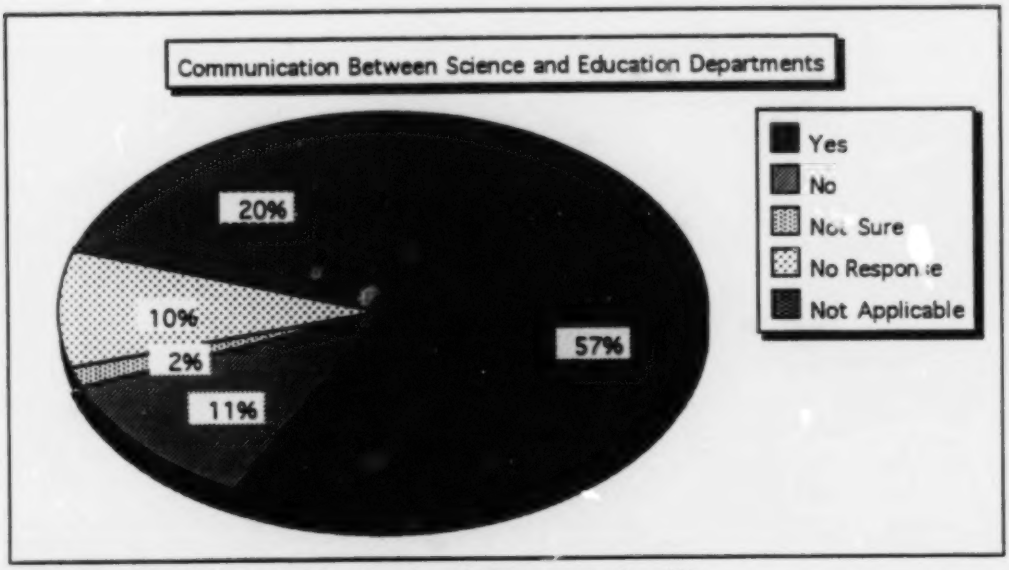

Figure 5. Percentage of Institutional Responses (n=61)
Is there communication between the science department and the education department at your institution?

region service centers at their institution. The remaining seven percent did not respond to the question (Figure 6).

Public institution respondents indicated the largest percentage of input received from school districts or region service centers. Private institutions and preparation programs both showed larger percentages in the "no" category. Overall, the percentage for

"yes" responses was low. However, there appeared to be isolated instances of school district collaboration indicated in the descriptions provided by respondents. The following was a typical comment from a respondent describing input received from local school districts. "We are constantly communicating with at least 5 school districts in our area. We participate together in planning meetings and have on-going evaluation of our program."

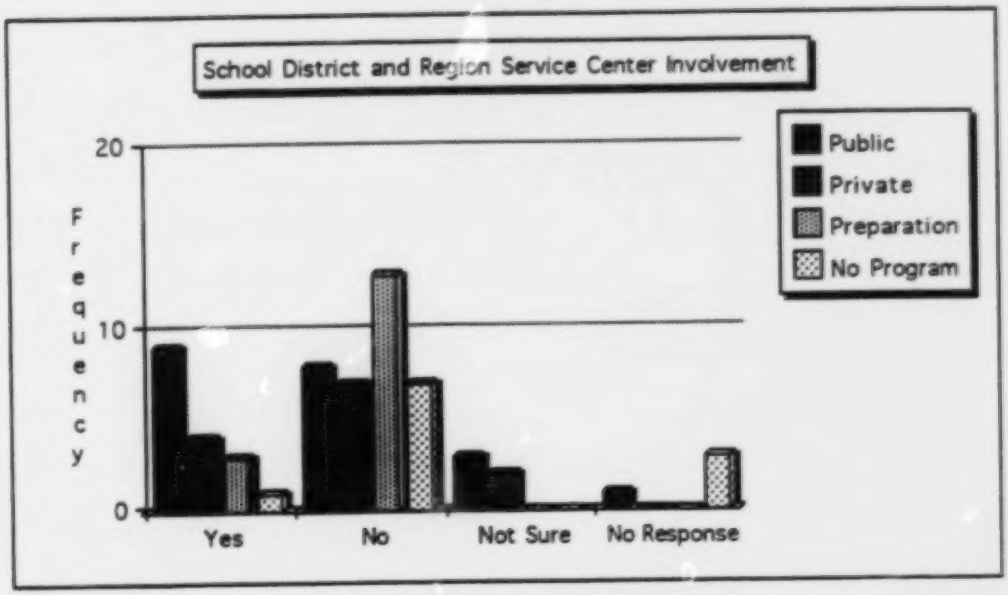

Figure 6. Frequency of Institutional Responses (n=61)
Have school districts and/or region service centers provided input to you concerning what is important to be taught in your science courses for elementary teachers?

Categories that developed from program descriptions provided by respondents included input via *informal discussions*, through *committee meetings*, by *direct contact with prospective elementary teachers*, and through *inservice programs determined by grants and surveys*. The following was a typical comment of a respondent indicating how grants and surveys helped to develop the science course sequence at the institution.

> Our science course sequence grew out of teacher inservice courses funded by grants. These courses were based on surveys of teachers and administrators in the area and were conducted in cooperation with the regional service center.

According to the respondents, teacher education programs showed some level of cooperation between education faculty and teachers in local school districts. However, it should be noted that collaboration was viewed as extending beyond the cooperation and coordination that occurs between education faculty and local school districts due to state classroom observation and student teaching requirements.

Category 3: Field-Based Teaching Experiences

Survey Question: Are there opportunities for prospective elementary science teachers to teach science in the public schools as part of a course at your institution?

Fifty-two percent of the respondents indicated that there were not opportunities to teach science, 30% said there were opportunities as part of a course, and 11% did not respond to the question. The remaining seven percent noted that opportunities to teach science as part of a course occurred through the education department, but there were no opportunities provided in courses taken through the science department (Figure 7).

Respondents representing public and private institutions both responded "yes" more often than "no" concerning opportunities to teach science in public schools as part of a course. However, respondents for preparation programs generally did not provide field experiences. This corresponds to the responses previously mentioned for instructional practice where a high number of respondents indicated a need for more information on field experiences in schools.

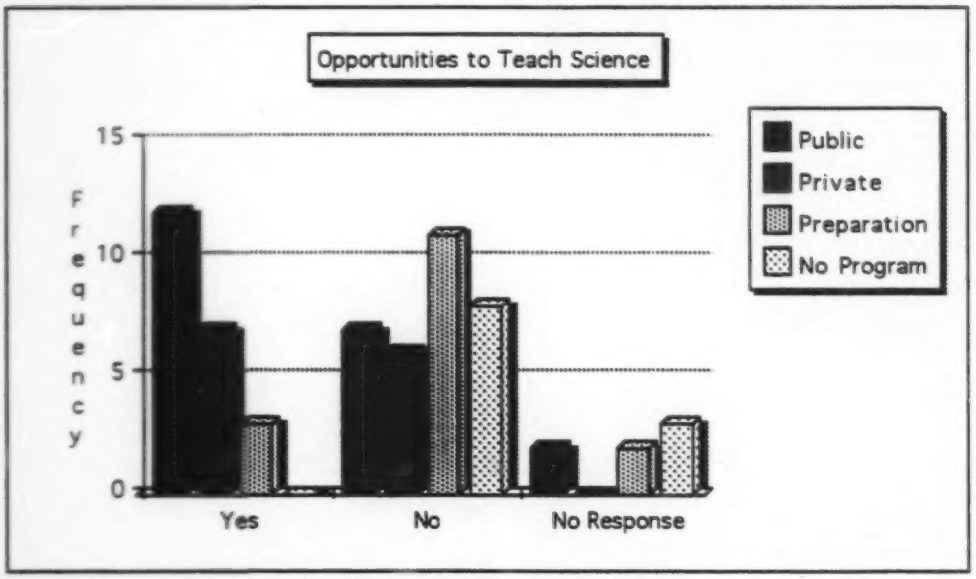

Figure 7. Frequency of Institutional Responses (n=61)
Are there opportunities for prospective elementary teachers to teach science in public schools as part of a course at your institution?

Respondents indicating that field experiences were provided in their course were asked to elaborate on these experiences. One category that emerged from the responses included *state requirements*. The respondents viewed the required experiences provided by student teaching and observation hours as adequate for the field experience component of their education program. A typical comment from respondents regarding required observation and student teaching practices for prospective elementary teachers was as follows. "Field experiences of 45 hours in elementary classrooms includes opportunities to teach science. Student teaching full time for one semester also involves science teaching."

Other categories that emerged from the content analysis included *participation in professional development schools* as part of methods courses, *"modeled" teaching* in simulated classroom settings during courses, *working with students* in local schools on special science projects as part of course requirements, and *programs especially designed* for early field experiences. The following was a comment from a respondent describing the program at the institution designed especially for early field experiences.

> We have a program that is completely field based. All courses are taught in a public school (Monday-Friday, 8:00-11:30 or 12:30-3:30). We offer course work containing theory, philosophy, and text work in conjunction with real world application. Students participating in this program are housed in a public school for three semesters. This enables them to have more than a years experience in the teaching field before graduation occurs.

Category 4: Professional Development and Continual Growth

Transition to Teaching Practice

Survey Question: Do you have a procedure for maintaining contact with and/or providing continued support for students who have completed the teacher certification or preparation program at your institution?

Do educational institutions in Texas provide a smooth transition into the teaching practice for graduates of their programs? Forty-four percent of the respondents indicated that there was not a procedure provided by their institution, 31% described a procedure at their institution, and 20% did not respond or did not feel the question was applicable at their institution. Five percent of the respondents were not sure if their institution provided such a procedure (Figure 8).

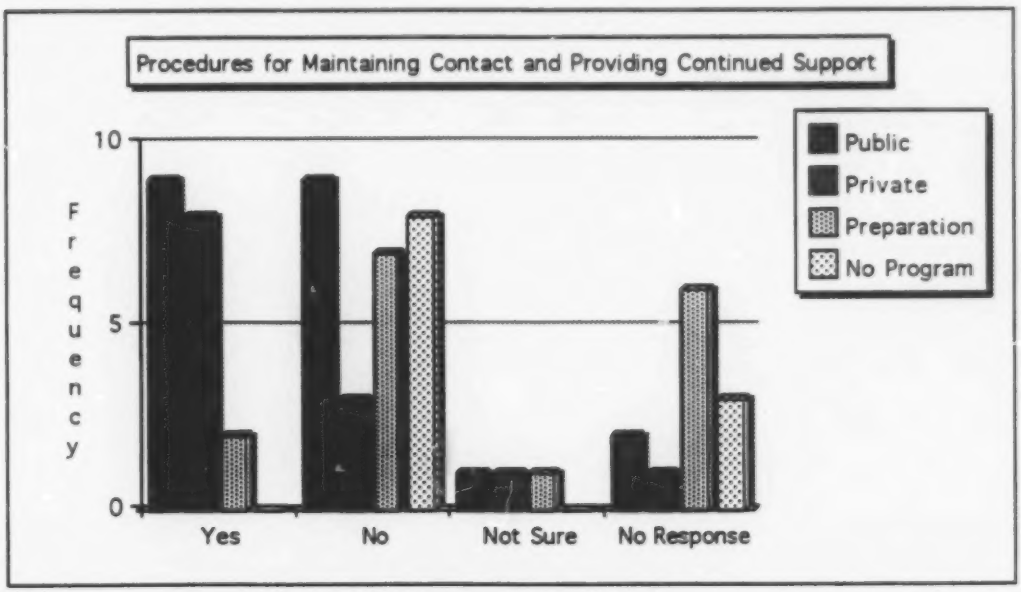

Figure 8. Frequency of Institutional Responses (n=61)
Do you have a procedure for maintaining contact with and/or providing continued support for students who have completed the teacher certification or preparation program at your institution?

Respondents representing private institutions indicated a follow-up procedure in more instances than did respondents representing public institutions or preparation program institutions. Three categories emerged from content analysis of "yes" responses describing the follow-up procedures at various institutions. In the first category, follow-up procedures were provided by *surveys or questionnaires* sent to graduates. The following was a typical response that described the survey or questionnaire follow-up procedure. "Follow-up questionnaires are mailed to each building administrator who hires our certified candidates. This provides our office with knowledge as to the strengths and weaknesses in program delivery." In the second category, respondents indicated *informal* follow-up procedures occurred at their educational institutions. A typical response that discussed this type of procedure follows. "Students frequently call or return for assistance, but it is done on an informal basis." The third category of responses discussed *regularly occurring* procedures at their institution. These procedures usually occurred in the form of summer workshops and periodic meetings to discuss teaching experiences. A few educational institutions described induction year programs for first year teachers.

Support to Novice Teachers

Survey Question: Does your institution provide support to novice teachers in their teaching of science?

Forty-six percent of the respondents noted that support was not provided to novice teachers in their teaching of science at their institution, 41% of the respondents indicated support provided to novice teachers, and 8% were unsure of the support provided to novice teachers at their institution. Five percent of the respondents did not answer the question (Figure 9). Over half of the respondents representing public institutions indicated support provided for novice teachers at their institution. On the other hand, approximately two-thirds of the respondents for private and preparation program institutions indicated that there was no support provided for novice teachers at their institution.

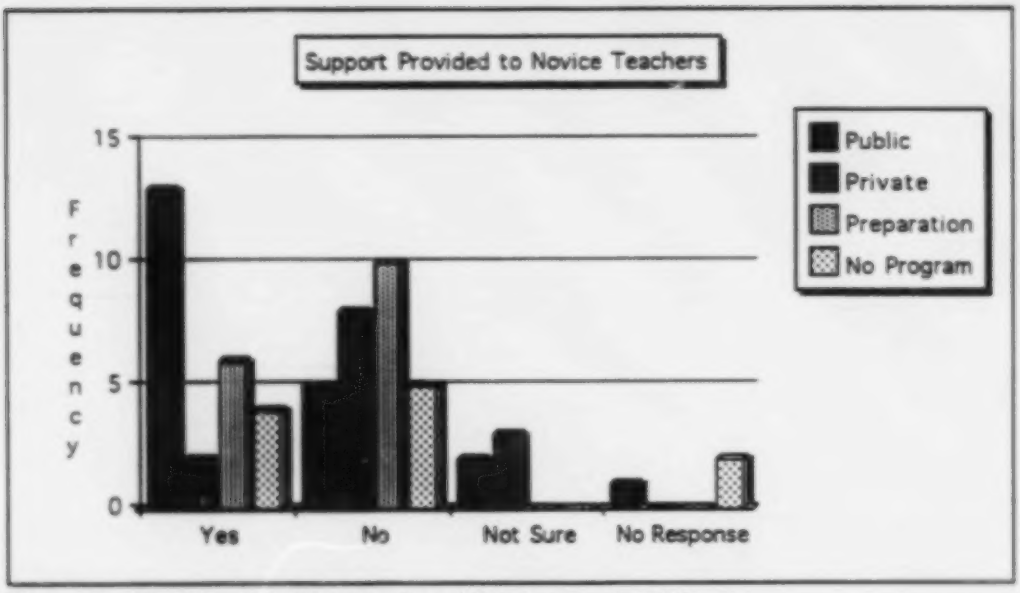

Figure 9. Frequency of Institutional Responses (n=61)
Does your institution provide support to novice teachers in their teaching of science?

When respondents were asked to describe the types of support provided by their institution, four categories developed. Respondents discussed the establishment of *mentor programs*, the development of *inservice training workshops*, the *informal practices* of ensuring support such as answering questions and telephone calls, and the willingness of institutions to *loan equipment* or act as a resource. The following was an example of a comment made by a respondent that described the willingness of the institution to loan equipment to novice teachers. "We are willing to loan various resources and equipment to new teachers that want to do class demonstrations for their students."

Professional Development

Survey Question: Does your department actively encourage new methods for professional development in teaching science?

Sixty-one percent of the respondents indicated active encouragement on the part of their institution to new methods of professional development while 28% said their

institution did not encourage such development. There was a "no response" rate of 8%, and 3% indicated being unsure of the support at their institution (Figure 10).

Over 65% of the respondents representing public institutions and preparation program institutions indicated encouragement from their departments in professional development activities. Forty-six percent of the respondents from private institutions indicated encouragement while 55% of respondents from no program institutions agreed there was encouragement for professional development at their institution. Respondents were asked to identify how they currently participated in professional development activities. Fifty-eight of the respondents were involved in teacher education organizations, 48 respondents participated in science organizations, 47 respondents were involved in a collaborative, 60 respondents said they read articles related to their field, and 22 respondents wrote articles in their field. Twenty respondents chose not to answer this question.

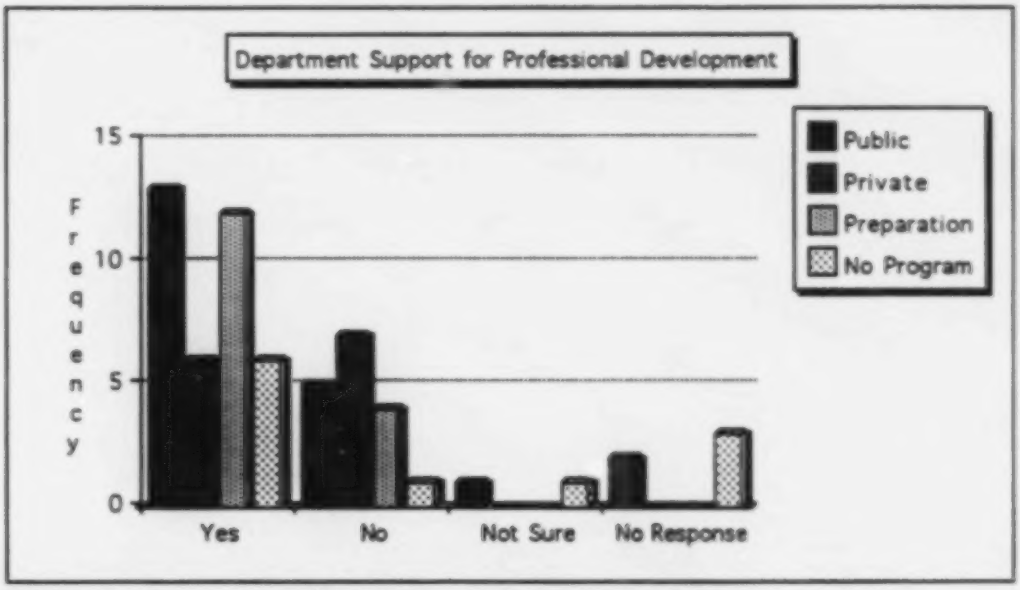

Figure 10. Frequency of Institutional Responses (n=61)
Does your department actively encourage new methods of professional development in teaching science (i.e., involvement in professional educational organizations, collaboratives, and/or presenting at conferences) for faculty?

Category 5: General Program

Program Characterizations

Survey Question: Characterize your institution as traditional, 5th year, graduate, endorsement, and/or other.

Educational certification and preparation programs were also classified in terms of overall structure. Currently, most Texas certification programs are traditional. Out of the 34 educational institutions surveyed that indicated having a certification program at their institution, 30 were characterized as traditional (i.e., the program occurs at the undergraduate level, and students take four to five years to complete the program). There were six institutions each characterized as providing special endorsements as well as providing graduate work at the institution. Two institutions were identified as fifth-year institutions. Also, two institutions described the professional development schools at their institution.

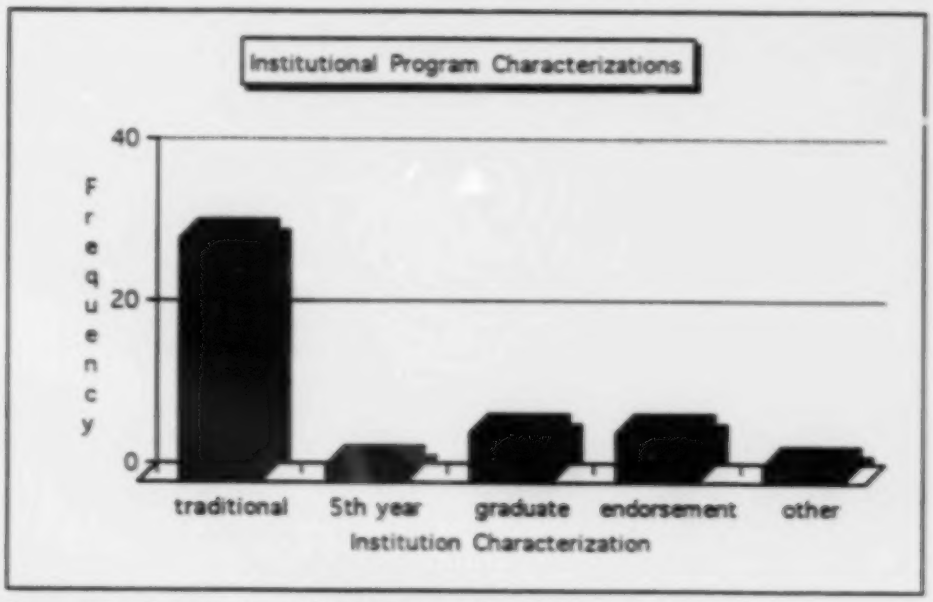

Figure 12. Frequency of Institutional Responses (n=34)
Characterize your institution as traditional, 5th year, graduate, endorsement, and/or other.

National and State Documents in Curriculum Development

Survey Question: Have national and state documents (i.e., Benchmarks, National Science Education Standards, and Texas Essential Elements) been used in designing the science certification or preparation courses at your institution?

Over half of the respondents (53%) indicated that these documents had been used in course design considerations at their institution while 24% of the respondents said that these documents were not considered. There was a "no response" rate of 22%, and 1% of respondents were unsure of the use of these documents (Figure 12). Respondents generally indicated that public and private institutions have incorporated documents, such as Benchmarks, National Science Education Standards, and Texas Essential Elements, into the curriculum of science certification courses at their institution. However, only 25% of the respondents from preparation programs indicated the use of these documents in designing preparation courses.

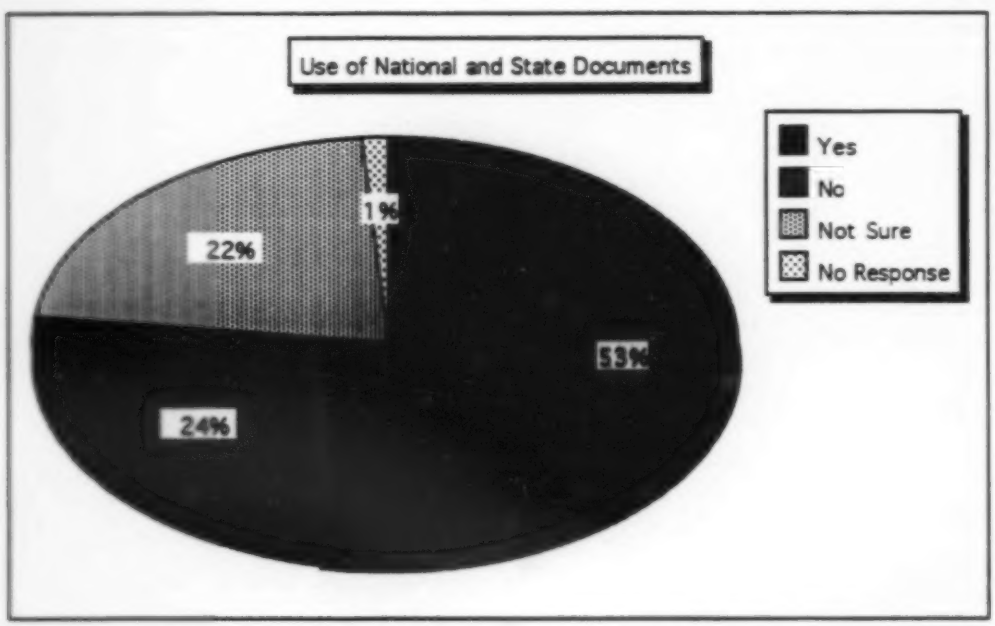

Figure 12. Percentage of Institutional Responses (n=61)
Have the above documents (i.e., Benchmarks, National Science Education Standards, Texas Essential Elements) been used in designing the science certification or preparation courses at your institution?

Science Course Instructors

Survey Question: Who most often teaches the science courses for prospective elementary teachers at your institution?

Sixty percent of the respondents indicated that faculties of science were responsible for science course instruction. Twenty percent of the respondents said science course instruction was the responsibility of both science and education faculties at their institution. Five percent of the respondents indicated that the instruction in science courses was the responsibility of faculties of education. Fifteen percent of the respondents did not answer this question.

Program Satisfaction

Survey Question: Are you satisfied that the course or courses on your campus sufficiently prepare elementary teachers to teach science?

When asked this question, 41% of the respondents said "yes" courses at their institution do prepare future teachers of science. There were 38% indicating dissatisfaction with their institution in terms of preparing teachers of science. Sixteen percent of the respondents chose not to answer this question, and five percent of the respondents were unsure of program success at their institution (Figure 13).

Generally, respondents indicated they were satisfied that the course or courses at their institution sufficiently prepared elementary teachers to teach science. This was true for public, private, and preparation program institutions. However, many of the respondents representing the no program institutions indicated that they were not satisfied with the preparation of teachers to teach science at their institution.

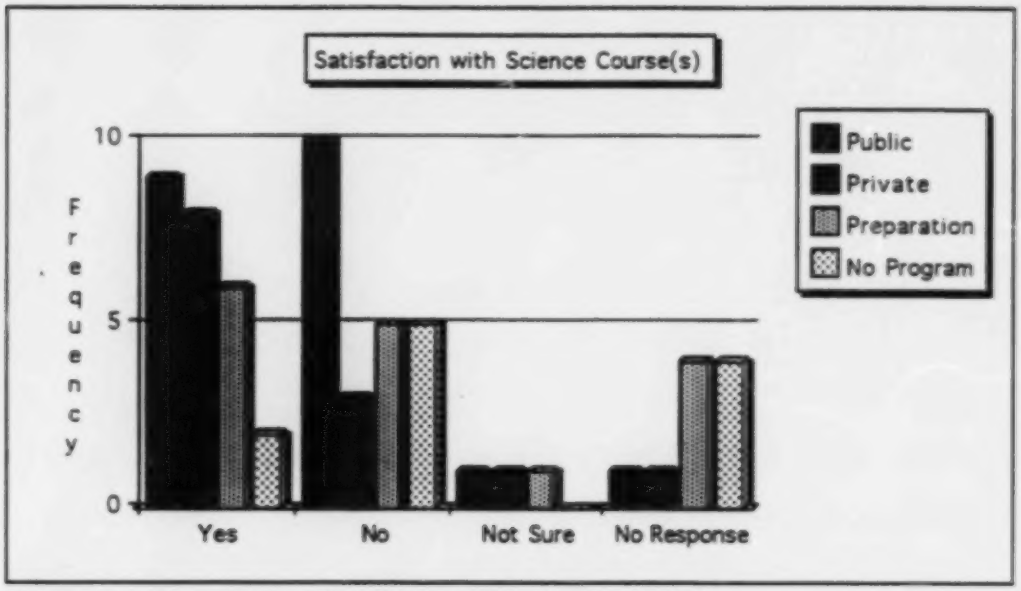

Figure 13: Frequency of Institutional Responses (n=61)
Are you satisfied that the course or courses on your campus sufficiently prepare elementary teachers to teach science?

Needs of Elementary Science Teachers

Survey Question: What do you know about the special needs of elementary teachers in regard to their needs in teaching science?

What are the needs of elementary science teachers? Four categories developed when examining responses made by survey participants: (1) *overcoming fear*; (2) *science content knowledge*; (3) *lack of equipment and resources*; and (4) *pedagogical aspects*. First, respondents indicated that elementary science teachers need to overcome the fear of teaching science. Second, respondents discussed the science content knowledge that is lacking for many elementary teachers. Third, respondents described the needs of elementary teachers in terms of lack of equipment and resources for elementary science instruction. Finally, the fourth dealt with the pedagogical aspects of elementary science teaching. Respondents discussed the various instructional practices of elementary teachers and how science content should be delivered. Table three provides representative comments in each category, which have been ranked ordered from more to less frequent.

Ideas Gained From Certification or Preparation Program

Survey Question: What do you believe is the most important idea prospective elementary science teachers should gain from a certification program or preparation program? Please explain.

What do respondents feel is the most important idea to be gained from a certification or preparation program? This question spurred responses organized into five categories. As mentioned as a primary need of elementary science teachers, the first category considered a strong *foundation in basic scientific concepts*. Responses comprising category two considered the *nature of science* and the learning of scientific concepts. Category three focused on the *pedagogy of elementary teachers* in terms of being able to create meaningful activities and utilize a variety of instructional strategies. Category four discussed the importance of *attitude* with regard to the teaching of science. Respondents emphasized the importance of enthusiasm and flexibility. Respondents also realized the importance of *modeling science* as being fun, useful and important. The final category included responses recognizing the power of and the need for commitment to *life-long learning* and continual development on the part of elementary teachers. Table four provides representative comments in each category, which have been ranked ordered from more to less frequent.

Table 3. Needs of Elementary Science Teachers

Category	Sample Comments
(1) Overcoming Fear	• *"Many have a high anxiety level toward science and tend not to teach it.."* • *"Elementary teachers exhibit a fear of science which must be overcome."* • *"They need to develop science confidence."*
(2) Science Content Knowledge	• *"I have no students that are adequately prepared with the necessary background knowledge to teach science. It is impossible for two required science college courses to make up for the students' inadequate academic backgrounds."* • *"My past experiences in public schools with elementary teachers led me to believe that they did not have the background for teaching science or it just was not high in their priorities. Probably, more background is needed in science through better programs in college or more inservice."*
(3) Lack of Resources	• *"Elementary teachers have little supplies and support, and they need to overcome this."* • *"They need to know how to create and do labs that require little time and money."*
(4) Pedagogical Aspects	• *"Elementary teachers need opportunities to engage with science content in investigative ways and to reflect on scientific ways of exploring science so that these methods can be used in the classroom."* • *"Time is needed to play with the same ideas and concepts that they will teach their children. Ideas are needed as to how to instruct children in science."*

Table 4. Ideas Gained From Certification or Preparation Program

Category	Sample Comments
(1) Scientific Concepts	• *"If you do not possess the basic concepts of all areas of science (biology, chemistry, physics, geology, astronomy), you will not be able to teach science effectively. you must first possess knowledge before you can convey that knowledge to someone else."* • *"Elementary teachers need a knowledge of the nature of science and scientific processes. No amount of technique and method can substitute for knowing the scientific concepts and principles."*
(2) Nature of Science	• *"Science is a field of study that is both theoretical and empirical. Scientific thinking involves visual, verbal, and emotional ways of knowing."* • *"Science is fundamental in understanding the world in which we live."*
(3) Instructional Strategies	• *"The use of a variety of instructional strategies is the key to promoting learning."* • *"Content is important, but presentation of content is critical for K-6."* • *"One must incorporate many activities into their lessons and to see how easy it is to integrate science into other subject areas."*
(4) Science as Fun	• *"Science is important and should be taught in their classrooms."* • *"Elementary teachers and their students can do science, and it is fun."* • *"They should have an enthusiasm for science as well as an understanding on the level at which they are teaching."*
(5) Life-long Learning	• *"What you learn in school is just a beginning. Life-long learning about science is needed for effective teaching."* • *"State requirements are only minimally representative of what elementary teachers need to learn to be good science teachers. Even well-designed classes only introduce ideas--elementary teachers will need to follow up with ideas on their own with in-service meetings and enhancement activities once they are teaching."*

Discussion

This analysis was primarily descriptive with the intent to determine the *state of the state* with regard to preservice elementary science preparation. Data analysis focused on categories that represented the various ways in which programs teach science and science pedagogy, collaborate among faculties of science and faculties of education, provide essential field experiences, and prepare for professional growth and development. Data analysis also considered the overall program structure when necessary to determine any innovations included in elementary teacher preparation to reach or strengthen program goals.

Science Content and Pedagogy

How can educational institutions in Texas strengthen science content and pedagogy for prospective elementary teachers?

Texas educational institutions are generally traditional in their approach to teaching science and science pedagogy. Lecture is the predominant instructional strategy used by instructors throughout the state. The professional development standards emphasize learning science through investigation and inquiry rather than by lecture and reading. The integration of technology into science education and general science courses is also desirable. Technological products provide tools that promote understanding of natural phenomena; and technology provides students and instructors with exciting tools to conduct inquiry and to understand science (NCR, 1995). Students who are provided with opportunities to observe the use of technology also have opportunities to be active and participate in its use.

Changing the pedagogical practices of higher education is a necessary condition for changing the pedagogical practices in schools. In institutions of higher education, two and four-year college professors can model exemplary science pedagogy and science curriculum practices incorporating the instructional strategies of investigation and inquiry (NRC, 1995).

National and state documents, such as Benchmarks, Texas Essential Knowledge and Skills, and National Science Education Standards provide direction for the teaching and the learning of science. These documents can be important resources for any individual involved in science education.

Educational institutions can explore non-traditional innovative methods for delivering science content and pedagogy. The culture of higher education is such that the requisite changes will occur only if individual professors take the initiative. Concerned administrators can encourage and support such change. In addition, they can coordinate the efforts of science and education faculty in the planning of courses and programs for prospective teachers (NRC, 1995). The emerging *Guidelines* for preservice elementary science preparation in Texas, which will be published in the Spring of 1997 by the Texas Statewide Systematic Initiative, will summarize ways educational institutions in Texas can strengthen preservice elementary science programs.

Collaboration

How can educational institutions in Texas develop and implement collaborative efforts to strengthen the science preparation of prospective elementary teachers?

Responsibility for strengthening science instruction lies not with a single group of individuals but with several groups that can function as collaborators in planning and implementing changes (Raizen & Michelsohn, 1994). Public institutions, private institutions, community colleges, and junior colleges all have roles to play in the process. Successful collaborations must be built on mutual need and a commitment to preparing future teachers of science. There can be less emphasis on individual learning and more emphasis on collegial and collaborative learning (NRC, 1995).

Collaborative partnerships at educational institutions throughout the state are limited. Generally, institutions implement programs within departments--only communicating and cooperating with other departments or school districts when necessary to handle state guidelines and requirements. Establishing lines of

communication at institutions between departments of science and departments of education is an important first step in strengthening elementary science preparation. Communication between departments can lead to collaborative opportunities for departments of science and education to work together in designing and implementing courses (Hord, 1986). Educational institutions can create formal and informal avenues for facilitating and encouraging collaboration within institutions, and among institutions within the state to strengthen preservice elementary science preparation.

Early Field-Based Experiences

How can educational institutions in Texas provide early field-based experiences in science for prospective elementary teachers?

It is difficult to prepare preservice elementary teachers to teach science well without providing opportunities for them to practice with experienced teachers. Prospective preservice teachers can be provided with opportunities to reflect on their study of science content and science pedagogy (Raizen & Michelsohn, 1994). There can no longer be a separation between science knowledge and teaching knowledge. Educational institutions can emphasize the integration of science knowledge and teaching knowledge in school settings since some of the most powerful connections between science teaching and learning are made in field experiences (NRC, 1995). Field experience begins early in the preservice program and continues throughout the teaching career. The involvement in teaching situations, continual thoughtful reflection, interaction with peers combined with teaching science content characterizes expert teachers of science.

Early field experiences can occur beyond a classroom setting. Trips to nearby points of interest, such as a river, archaeological site, or zoo can be incorporated and linked to course content. Collaborating with local schools, other colleges and universities, local industry, and science-rich centers can create opportunities to provide essential field experiences for prospective elementary teachers. Some educational institutions in Texas

have implemented early field experiences for prospective elementary teachers. However, more institutions can be encouraged to implement curricular changes that would strengthen and institutionalize early field-based experiences for prospective elementary teachers.

Professional Growth and Development

How can educational institutions in Texas provide professional growth and development opportunities?

The professional development for teachers of science is a continuous process. Continuous professional development begins with a gradual shift from a university setting to a public school setting (NRC, 1995). Universities can provide support for novice teachers by providing workshops, by establishing mentor programs, or by developing support networks (Johnston & Kay, 1987). Induction year programs are also beneficial. In a survey of first-year teachers, teachers who were part of an induction year program were more confident about their effectiveness and happier in their careers than first-year teachers not involved in an induction program (Huling-Austin & Murphy, 1987). Institutions can be effective in providing support to novice teachers by creating a support structure at their institution that provides guidance and encouragement to new teachers (Raizen & Michelsohn, 1994). Also, procedures for maintaining contact with graduates are an important part of an educational program that prepares teachers. These procedures help to make the transition from preservice to practice easier for novice teachers. Follow-up procedures can also provide opportunities for program evaluation and assessment. Assessment measures can provide information on individual progress as well as help determine program success (NRC, 1995).

Some institutions across the state have designed and implemented such programs. However, there are still a vast majority of traditional teacher preparation programs that are limited in the opportunities they provide for faculty members, preservice teachers, or others to be connected to the teacher preparation process. These limitations have created

a need for teacher preparation programs that involve inservice teachers and faculties of science and education departments in the professional development of preservice teachers, and at the same time create opportunities for their own professional development (Parsons & Reynolds, 1995). Educational institutions can incorporate strategies or develop department incentives for encouraging continued professional growth and development of faculty.

Finally, throughout the results and discussion, the no program institution category consistently showed a high "no response" rate, and many times responses in the "no" category yielded a high percentage also. In analyzing data from the respondents of this category, often questions were not applicable. However, it is important to realize that institutions in this category are key players in strengthening science education. Although there is no program established, prospective elementary teachers enroll in science courses at these institutions and later transfer to a four-year institution for teacher certification. The science content and pedagogical practices learned in these courses are often what these prospective teachers take to their own classrooms.

Conclusion

Strengthening science education in such a comprehensive way will take commitment and a desire to better prepare future teachers of science. Considering the many structural and social problems that continue to plague the nation's schools and the few changes that have occurred over the past decade, it seems that substantive reform in science education will require a collaborative effort of major proportions from a broad base of individuals and institutions working concurrently on all levels, from elementary schools to universities. The science education of preservice elementary school teachers is a critical component in this systemic approach necessary to make real and lasting change a classroom reality (Raizen & Michelsohn, 1994).

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Appendix A:

LIST OF EDUCATIONAL INSTITUTIONS

Public Institutions with Certification Programs (n=21)

Angelo State University
East Texas State University
East Texas State University - Texarkana
Huston-Tillotson College
Midwestern State University
Prairie View A&M University
Sam Houston State University
Southwest Texas State University
Stephen F. Austin State University
Tarleton State University
Texas A&M University - Corpus Christi
Texas Tech University
Texas Wesleyan University
University of Houston - Downtown
University of North Texas
University of Texas at Austin
University of Texas at Brownsville
University of Texas at Pan American
University of Texas at San Antonio
University of Texas at Tyler
West Texas A&M University

Private Institutions with Certification Programs (n=13)

Abilene Christian University
Baylor University
Dallas Baptist University
Hardin-Simmons University
Howard Payne University
Lubbock Christian University
Our Lady of the Lake University
St. Mary's University
Texas Christian University
Texas Lutheran College
University of Mary Hardin-Baylor
University of St. Thomas
Wayland Baptist University

Institutions with Preparation Programs (n=16)

Angelina College
Alvin Community College
Clarendon College
El Paso Community College
Kilgore College
Kingwood College
Laredo Community College
Lee College
Midland College
Navarro College
San Antonio College
San Jacinto Community College
South Plains College
Texarkana College
Tyler Junior College
University of Texas at Dallas

Institutions with No Program (n=11)

Amarillo College
Brazosport College
Collin County Community College
Houston Community College
LeTourneau University
North Central Texas College
Palo Alto College
Richland College
Tarrant County Junior College
Temple Junior College
Weatherford College

Appendix B:

Texas Statewide Systemic Initiative (Texas SSI)

A Survey of Elementary Science Teacher Preparation in Texas

Identification Number _____

Throughout Texas there is a wide variation in the science preparation of elementary teachers. Some colleges and universities offer specific science courses for elementary education candidates; others offer preparation courses for students who may later enter into a teacher certification program. Still, other institutions may not have a teacher certification or preparation program, yet science courses are offered to students who may later enroll in a certification program at another institution.

The following questions refer to aspects of science content and/or the teaching of science courses. These courses may be considered in the context of an elementary science certification/preparation program or in the context of a science course offered within a science department.

For the following questions, if the information is not known or does not apply to you, please leave the response blank.

Part I: General Teacher Certification and/or Preparation

1. Does your institution offer a certification program for elementary teachers?

   _____Yes _____No

2. Does your institution offer preparation courses for elementary teachers?

   _____Yes _____No

3. Does your institution offer special endorsements (i.e., bilingual education, early childhood education, special education)?

   _____Yes _____No

4. Indicate the number of students **currently enrolled** in the teacher certification/ preparation program, or seeking a special endorsement. Please mark <u>all</u> that apply.

Special Endorsement	Elementary (1-6)	Elementary (1-8)	Secondary (6-12)	All Level (1-12)	Other (specify)

5. Indicate the number of students **completing or graduating** from the certification program for each academic year specified.

	1990-1991	1991-1992	1992-1993	1993-1994	1994-1995
Special Endorsement					
Elementary (1-6)					
Elementary (1-8)					
Secondary (6-12)					
All Level (1-12)					
Other (Specify)					

6. Indicate if the elementary teacher certification program/endorsement: (Check all that apply)

_____ is state approved
_____ is NCATE-approved
_____ meets NASDTEC standards
_____ meets other accreditation criteria (specify)
_____

7. Do you have a procedure for maintaining contact with and/or providing continued support for students who have completed the teacher certification or preparation program?

_____Yes _____No

8. If you answered yes to question 7, briefly describe the procedure used by your institution.

_____
_____

9. Does your institution have a procedure for identifying prospective preservice elementary teachers?

_____Yes _____No

10. If you answered yes to question 9, at what stage does this procedure occur. (Specify)

_____
_____

Part II: Certification and/or Preparation for Science Teaching

11. Does your institution offer a **certification program** that specifies the **teaching of science**?

_____Yes _____No

If you answered yes, please attach any documents that may apply.

12. Also, if you answered yes to question 11, at what levels is the certification program offered?

_____ Elementary Level
_____ Middle Level
_____ Secondary Level
_____ Other (Specify) _____

13. If your institution offers science preparation courses toward a certification program, please **list these courses**.

_____
_____
_____
_____
_____

14. Below is a list of the various state science options or teaching fields for elementary and secondary certification. Please mark the options offered by your institution. Also, indicate the science courses offered at your campus relative to these state options.

STATE OPTIONS	CERTIFICATION PROGRAM		SCIENCE COURSES
	Elementary	Secondary	
Life Science			
Earth Science			
Geography			
Biology			
Chemistry			
Physics			
Physical Science			
Science Composite			
Other (specify)			

15. Indicate if the science teacher certification program at your institution (Check all that apply)

_____ is state-approved
_____ is NCATE-approved
_____ meets NASDTEC standards
_____ meets other accreditation criteria
(specify)_____

16. How would you characterize your program? (Check all that apply)

_____ Traditional undergraduate certification program
_____ 5th year program
_____ Graduate program
_____ Endorsement
_____ Other (specify) _____

17. What courses are offered at your institution specifically for preservice elementary teachers?

_____ Methods course(s)
_____ Science course(s)
_____ Other (Specify) _____

18. If you identified a methods course in question 17, please check all that apply

_____ Methods course(s) for teaching science for K-12 (nonspecified)
_____ Methods course(s) specifically for teaching science at the elementary level
_____ Methods course(s) specifically for teaching science at secondary level
_____ Methods course(s) combining the teaching of science with other content areas (specify) _____
_____ Other (specify) _____

19. Please highlight any unique or innovative features of your program.

_____
_____
_____
_____
_____
_____

Part III: Content and Teaching of Science Courses

20. How are curriculum guidelines for the science courses or course sequence established?

_____ The course or course sequence is well established and the curriculum is set.
_____ Curriculum is established by the individual instructor.
_____ Curriculum is established jointly by the instructors who teach the course.
_____ Curriculum is established by the department.
_____ Other (Describe) _____

21. Check the documents of which you are aware.

_____ Benchmarks for Science Literacy (American Association for the Advancement of Science)
_____ The National Science Education Standards (National Research Council)
_____ Texas Essential Elements of Instruction

22. Have the above documents from question 21 been used in designing the science certification or preparation courses at your institution?

_____Yes _____No

23. Are there science laboratory experiences provided for prospective elementary teachers at your institution?

_____Yes _____No

24. If you answered yes to question 23, please describe these laboratory experiences.

_____
_____
_____

25. Are there opportunities for prospective elementary science teachers to teach science in the public schools as part of your course?

_____Yes _____No

26. If you answered yes to question 25, please describe these teaching opportunities.

_____
_____
_____

27. Do you currently teach a science course designed for prospective elementary science teachers?

_____Yes _____No

28. Have you previously taught a science course designed for prospective elementary science teachers?

_____Yes _____No

29. If you answered yes to question 28, how many years have you taught these courses?

_____ years

30. Please list the courses you have taught for prospective elementary science teachers.

_____

_____

_____

_____

31. What is your predominant teaching style?

_____

32. Who most often teaches the science courses for prospective elementary teachers on your campus?

_____ Professors of education
_____ Professors of science
_____ Graduate students
_____ Teaching assistants
_____ Other (Specify) _____

33. Are various technologies (i.e., computers, multimedia, laboratory equipment) used in the science education or general science courses at your institution?

_____Yes _____No

34. If your answer to question 33 was yes, please describe this technology.

_____

_____

_____

35. Is there communication between your science department and your education department in regard to preparing elementary teachers?

_____Yes _____No

36. If you answered yes to question 35, briefly describe this communication.

_____

_____

_____

37. Have school districts or region service centers provided input to you concerning what is important information to be taught in your science courses for elementary teachers?

_____Yes _____No

38. If you answered yes to question 37, describe how school districts or region service centers have offered input.

_____

_____

_____

39. Does your institution provide support to novice teachers in their teaching of science?

_____Yes _____No

40. If you answered yes to question 39, describe how your institution has offered support to novice teachers.

_____

_____

_____

41. Does your department actively encourage new methods for professional development in teaching science (i.e., involvement in professional educational organizations, collaboratives, and/or presenting papers at conferences) for faculty?

_____Yes _____No

42. If you answered yes to question 41, describe how your institution has actively encouraged new methods for professional development in the teaching of science.

_____

_____

_____

43. Do you currently (Please mark all that apply)

_____ participate in professional teaching organizations
_____ participate in professional science education organizations
_____ work with a collaborative, project, or grant that involves teacher preparation in some way
_____ read articles that address science courses for elementary teachers
_____ write articles that address science courses for elementary teachers

44. For the items marked in question 43, please elaborate on your current involvement.

_____

_____

_____

_____

_____

45. Are there faculty on your campus whose principle professional interest is K-8 science education?

_____Yes _____No

46. What do you believe is the most important idea prospective elementary science teachers should gain from a certification program or preparation program? Please explain.

_____

_____

_____

47. Are you satisfied that the course or courses offered on your campus sufficiently prepare elementary teachers to teach science?

_____Yes _____No

48. Are factors such as gender, ethnicity, socio-economic status, and developmental level integrated into the preparation of K-8 science teachers?

_____Yes _____No

49. What do you know about the special needs of elementary teachers in regard to their needs in teaching science?

_____

_____ _____

_____

50. Use the following information to respond to the items below.

1 = Need more information
2 = Am aware of the general principles
3 = Would like to try in my class
4 = Have tried somewhat
5 = Have incorporated as a part of my class

Cooperative learning/Working in groups ____

Alternative assessment _____

Integration of technology _____

Hands-on labs _____

Field experiences in the public schools teaching science _____

Team teaching _____

Real-world applications _____

Open-ended problem solving situations _____

Please attach any materials that provide a description of the nature and characteristics of the science teacher program and/or endorsement (i.e., annual performance reports, course syllabi, course requirements, clinical experiences, etc.)